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Agricultural Lime Analyses

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ADDRESS
DEPARTMENT OF CHEMISTRY, UNIVERSITY OF MARYLAND
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ANALYSES OF

Agricultural Lime Sold in Maryland

BY THE DEPARTMENT OF CHEMISTRY

UNIVERSITY OF MARYLAND

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The tables on the following pages contain the results of the analysis of agricultural lime for the year ending November, 1921.

The principal use of agricultural lime is to neutralize acid in the soil and its value for this purpose, either in the commercial oxide or burnt lime, slaked (hydrated) or carbonate of lime (either as ground limestone or oyster shells), depends on the amount of oxide of lime present. Oxide of magnesia is generally present to a greater or lesser extent in limestone and this is slightly more efficient than an equal amount of lime in correcting acidity, so that, for comparative purposes, the amounts of the two oxides should be added. High magnesia content, however, is frequently considered undesirable.

It should be remembered that commercial lime will vary somewhat in composition, even from the same quarry, from time to time, so that a few points in favor of a certain brand, as against another brand, may mean nothing, as the figures may be reversed in the next analysis.

All the forms of lime mentioned are good and the form to use depends on local conditions—the kinds available, the comparative prices, cost of freight, distance of haul, ease and cheapness of application, etc.

All forms are best applied on top of plowed ground and harrowed in. Quick lime, hydrated lime and gas lime should be applied some time before sowing the crop. Quick lime soon takes up water and slakes when spread out and then takes up carbonic acid gas and is converted to the carbonate, similar, chemically, to the original limestone, but is finely subdivided.

The proper fineness when ground limestone is used is a point on which there are differences of opinion and, again, should depend somewhat on local conditions. All agree that the finer the grinding the quicker the action and the sooner the lime will be used up. Where a coarser product is much cheaper and the freight and hauling comparatively small, the coarser product may be used to advantage, using more of it to the acre and applying less frequently.

In most cases it is desirable that ground limestone, shells, etc., be so fine that the greater part will pass a 60-mesh sieve. In this case much of it will be finer than 60-mesh. That coarser than 20-mesh is very slowly available and much less valuable. The fineness is determined by using sieves with different sizes of mesh. "60-mesh" is a sieve made of wire cloth with 60 wires to the linear inch in both directions.

It will be noted that in case of the quicklimes in the table that the sum of the oxides of lime and magnesia and the insoluble matter will fall short of 100 per cent. The difference is made up of carbon dioxide gas, oxides of iron and alumina, water, etc. In practice the carbon dioxide is never completely driven out of lime in burning; frequently from 2 to 5 per cent., and even more, will remain in the quicklime. The latter also slowly takes up this gas, as well as water, from the air on standing.

Lime, in connection with clover, or other legumes, will, to a large extent, take the place of the expensive nitrogen (ammonia) of commercial fertilizers, but will not greatly relieve the necessity for phosphates and potash.

Lime should be handled, when possible, in carload lots, to avoid unnecessary expense. Where one farmer does not need so much at one time he should be able to arrange with one or more neighbors to get a full car.

A ton of quick lime or two tons of ground stone or shells is a very common amount to apply per acre.

The comparative values of different limes depend, largely, on the respective amounts of actual Lime (Calcium Oxide) present, to which should be added the Magnesia. Insoluble matter, water, carbon dioxide, etc., may be classed as fillers.

Some grinders of limestone and shells give the guarantee as "carbonate of lime." This is unlawful and misleading, as the percentage is nearly twice that of actual lime. 100 lbs. of carbonate of lime contains 56 lbs. of actual lime—oxide of calcium.

ANALYSES OF AGRICULTURAL LIME

No.	Name of Manufacturer or Agent	Name of Lime	Place of Sampling	Calcium Oxide CaO		Magnesium Oxide MgO		Sand and Insoluble (of no value)	
				FOUND	Guaranteed	FOUND	Guaranteed	FOUND	Guaranteed
1243	Alba Marl Lime Co., Charles Town, W. Va.	*Alba Marl	Ellicott City	**50.86**	50.00	**.49**		**4.35**	
1226	Baltimore Lime & Stone Co., Baltimore, Md.	Burnt Lump Lime	Texas	**80.86**	85.00	**3.00**		**7.65**	
1244	Baltimore Pulverizing Co., Baltimore, Md.	*Agricultural Lime	Baltimore	**43.68**	50.00	**.25**		**16.65**	
1267	J. E. Baker Co., York, Pa.	Empire Lime	York, Pa.	**91.61**	85.00	**1.45**	3.00	**.80**	
1268	J. E. Baker Co., York, Pa.	Susquehanna Hy'd Lime	York, Pa.	**65.07**	50.00	**8.63**	2.00	**2.00**	
1269	J. E. Baker Co., York, Pa.	*Victor Fine Gr. Limestone	York, Pa.	**49.95**	47.00	**4.32**	2.00	**2.34**	
	O. E. Barber Fertilizer Co., Barber, Va.	†Precipitate Lime			51.50				
1219	S. W. Barrick & Sons, Woodsboro, Md.	Agricultural Lump Lime	Woodsboro	**80.97**	85.00	**5.88**	5.00	**5.56**	
1235	S. W. Barrick & Sons, Woodsboro, Md.	Fresh Ground Lime	Woodsboro	**64.06**	85.00	**3.35**		**13.28**	
1220	S. W. Barrick & Sons, Woodsboro, Md.	*Ground Lime	Woodsboro	**64.40**	85.00	**5.62**	5.00	**11.01**	
1221	S. W. Barrick & Sons, Woodsboro, Md.	Hydrated Lime	Woodsboro	**58.12**	65.00	**5.12**	3.00	**8.88**	
1239	Beaver Dam Marble Co., Cockeysville, Md.	*Dolomitic Limestone	Cockeysville	**29.79**	30.00	**19.38**	20.00	**4.52**	
1227	Beaver Dam Marble Co., Cockeysville, Md.	*Ground Stone Lime	Cockeysville	**29.12**	30.00	**18.12**	20.00	**9.12**	

	F. & H. Benning Oyster &	†Ground Oyster Shells			50.00				

	F. & H. Benning Oyster & Lime Co., Galloways, Md.	†Ground Oyster Shells			50.00			
1247	Blair Limestone Co., Martinsburg, W. Va.	Opequon Hydrated Lime	Martinsburg, W. Va.	65.85	65.00	1.59	2.00	5.10
1246	Blair Limestone Co., Martinsburg, W. Va.	Spec. Agr'l Lime	Martinsburg, W. Va.	56.22	60.00	1.63		5.75
1197	Herbert Bryant's Son, Alexandria, Va.	*Pulverized Oyster Shells	Gaithersburg	46.14	45.00	.47		5.98
	John E. Buffington, Union Bridge, Md.	†Agr'l Lump Lime			90.00			
	G. M. Bushey & Son, Cavetown, Md.	†Agr'l Lump Lime			90.00			
1265	Central Chemical Co., Hagerstown, Md.	Gro-All Hydrated Lime	Hagerstown	70.44	70.00	1.83	2.00	1.62
1211	Chesapeake Shell & Lime Co., Crisfield, Md.	*Ground Oyster Shells	Crisfield	43.34	50.00	.49		17.22
1258	Chesapeake Shell & Lime Co., Crisfield, Md.	*Ground Oyster Shells	Crisfield	49.05	50.00	.36		7.18
1212	Dorchester Fertilizer & Lime Co., Cambridge, Md.	Burnt Shell Lime	Cambridge	55.66	50.00	.35		4.50
1214	Dorchester Fertilizer & Lime Co., Cambridge, Md.	Hydrated Shell Lime	Cambridge	51.96	50.00	.12		8.70
1213	Dorchester Fertilizer & Lime Co., Cambridge, Md.	*Pulverized Oyster Shells	Cambridge	46.70	50.00	.47		11.10
1266	Emig Lime Co., Hellam, Pa.	Agr'l Lump Lime	Hellam, Pa.	88.14	86.00	1.41		2.07
1222	Fountain Rock Lime Co., Woodsboro, Md.	Agr'l Lump Lime	Fountain Rock	90.27	85.00	5.49	2.00	.79
1236	Fountain Rock Lime Co., Woodsboro, Md.	Ground Lime	Fountain Rock	65.31	85.00	2.59		14.70
1223	Fountain Rock Lime Co., Woodsboro, Md.	Hydrated Lime	Fountain Rock	53.65	56.00	4.76	2.00	10.73
1210	Fountain Rock Lime Co., Woodsboro, Md.	Old Reliable Lime	Mt. Airy	56.89	60.00	6.38		7.42
1224	Fountain Rock Lime Co., Woodsboro, Md.	Pulverized Lime	Fountain Rock	61.93	50.00	7.33	2.00	14.60
1202	M. J. Grove Lime Co., Lime Kiln, Md.	Agr'l Lump Lime	Groves	85.23	75.00	4.12		3.98

* Ground Shells or Stone, Mechanical Analysis on page 10. † Licensed but no sample.

ANALYSES OF AGRICULTURAL LIME—Continued

No.	Name of Manufacturer or Agent	Name of Lime	Place of Sampling	Calcium Oxide CaO		Magnesium Oxide MgO		Sand and Insoluble (of no value)	
				FOUND	Guaranteed	FOUND	Guaranteed	FOUND	Guaranteed
1203	M. J. Grove Lime Co., Lime Kiln, Md.	Fresh Ground Lime	Groves	**59.02**	75.00	**8.17**		**17.17**	
1204	M. J. Grove Lime Co., Lime Kiln, Md.	Hydrated Lime	Myersville	**50.40**	65.00	**6.15**	2.00	**20.80**	
1261	M. J. Grove Lime Co., Lime Kiln, Md.	*Pulverized Limestone	Lime Kiln	**52.97**	50.00	**1.25**		**2.59**	
1245	Hubbard Fertilizer Co., Baltimore, Md.	*Ground Oyster Shells	Baltimore	**46.59**	50.43	**.45**		**11.22**	
1225	O. J. Keller Lime Co., Buckeystown, Md.	Agr'l Lump Lime	Buckeystown	**94.64**	85.00	**1.01**		**.34**	
1199	Knickerbocker Lime Co., Philadelphia, Pa.	Hydrated Lime	Chestertown	**46.70**	45.00	**25.35**	30.00	**1.70**	
	Knickerbocker Lime Co., Philadelphia, Pa.	†Ground Limestone			44.00				
	Knickerbocker Lime Co., Philadelphia, Pa.	†Run of Kiln Lime			50.00		33.00		
1255	Legore Combination Lime Co., Legore, Md.	Agr'l Lump Lime	Legore	**94.75**	85.00	**.51**		**1.66**	
1234	Legore Combination Lime Co., Legore, Md.	Refined Hydrated Lime	Ellicott City	**53.98**	50.00	**5.18**		**12.07**	
1200	Legore Combination Lime Co., Legore. Md.	Refined Hydrated Lime	Centreville	**55.10**	50.00	**2.08**	1.00	**10.50**	
1228	W. P. Lindsay, Texas, Md.	Burnt Lump Lime	Texas	**80.08**	85.00	**1.75**		**13.19**	
1229	J. B. Logan, Texas, Md.	Burnt Lump Lime	Texas	**86.01**	85.00	**5.98**		**1.01**	
1205	McAleer Lime Co., Walkers-	Agr'l Lump Lime	Walkersville	**69.10**	80.00	**2.43**	1.00	**14.35**	

1205	McAleer Lime Co., Walkersville, Md.	Agr'l Lump Lime	Walkersville	**69.10**	80.00	**2.43**	1.00	**14.35**
1206	" " " "	Fresh Ground Lime	Walkersville	**66.19**	75.00	**2.65**	1.00	**13.42**
1207	" " " "	Hydrated Lime	Walkersville	**53.87**	50.00	**1.67**	1.00	**14.60**
1260	Maryland Lime Marl Co., Hagerstown, Md.	*Lime Marl	Hagerstown	**48.72**	50.00	**.54**		**11.40**
1270	Merion Lime & Stone Co., Norristown, Pa.	Hydrated Lime	Norristown, Pa.	**44.24**	45.00	**31.26**	30.00	**2.28**
1271	" " " "	Run of Kiln Lime	Norristown, Pa.	**56.10**	50.00	**39.24**	30.00	**.67**
1252	Michigan Limestone & Chemical Co., Buffalo, N. Y.	*Calcite Mich. Limestone	Buffalo, N. Y.	**55.10**	54.50	**.47**	1.00	**1.29**
1272	Natural Lime Marl Co., Roanoke, Va.	*Lime Marl	Roanoke, Va.	**51.86**	50.00	**.51**		**4.55**
1233	Orem & Winterbottom, Cambridge, Md.	Hydrated Shell Lime	Cambridge	**47.26**	50.00	**.55**		**4.90**
1248	Palmer Lime & Cement Co., York, Pa.	Agricultural Lime	York, Pa	**94.75**	88.00	**3.64**	6.00	**1.46**
1237	" " " "	Chal. Br. Hydrat. Lime	Vale	**69.77**	65.00	**2.24**	6.00	**.80**
1249	" " " "	*Ground Limestone	York, Pa	**50.84**	48.00	**3.77**	5.00	**1.56**
	Peerless Oyster Co., Baltimore, Md.	†Unburnt Oyster Shells			50.00			
1190	Potomac Lime Co., Colonial Beach, Va.	*Ground Oyster Shells	Mechanicsville	**50.27**	50.00	**.61**		**4.43**
1192	Potomac Poultry Food Co., Baltimore, Md.	*Oyster Shell Dust	Gaithersburg	**44.80**	50.43	**.61**		**12.23**
1191	Powhatan Lime Co., Strasburg Junction, Va.	Agr'l Hydrated Lime	Strasburg Junction, Va.	**71.34**	65.00	**1.39**	5.00	**.67**
1218	Salisbury Lime Co., Salisbury, Md.	Hydrated Shell Lime	Salisbury	**60.70**	60.00	**.17**		**6.62**
1238	Security Cement & Lime Co., Hagerstown, Md.	Hydra-Calcite	Dickerson	**60.59**	52.00	**2.57**	2.00	**1.72**
1193	" " " "	Hydrated Lime	Rockville	**70.78**	70.00	**1.81**		**.35**

* Ground Shells or Stone, Mechanical Analysis on page 10.

† Licensed but no sample.

ANALYSES OF AGRICULTURAL LIME—Concluded

No.	Name of Manufacturer or Agent	Name of Lime	Place of Sampling	Calcium Oxide CaO		Magnesium Oxide MgO		Sand and Insoluble (of no value)	
				FOUND	Guaranteed	FOUND	Guaranteed	FOUND	Guaranteed
1250	Security Cement & Lime Co., Hagerstown, Md.	*Pulverized Limestone	Hagerstown	**52.52**	44.00	**.84**		**3.66**	
1208	Shank & Etzler, Frederick, Md.	Agr'l Lump Lime	Frederick	**58.12**	60.00	**33.05**	15.00	**.64**	
1259	" " "	Agr'l Lump Lime	Frederick	**59.13**	60.00	**32.42**	15.00	**1.90**	
1209	" " "	Hydrated Lime	Frederick	**43.79**	40.00	**24.76**		**5.17**	
	Chas. E. Staley, Frederick, Md.	†Agr'l Lump Lime			90.00			**2.08**	
1254	Standard Lime & Stone Co., Buckeystown, Md.	Ground Lime	Buckeystown	**94.08**	90.00	**2.72**		**1.25**	
1195	" " "	Hydrated Lime	Gaithersburg	**70.22**	70.00	**1.13**		**1.84**	
1253	" " "	Standard Lime	Buckeystown	**94.64**	90.00	**.94**		**2.06**	
1201	" " "	*Pulverized Limestone	Greensboro	**51.57**	50.00	**1.06**		**4.32**	
1189	Geo. R. Staub, Union Bridge, Md.	Agr'l Lump Lime	Union Bridge	**92.06**	85.25	**1.67**	7.48	**.20**	
1262	Steacy & Wilton Co., Wrightsville, Pa.	Run of Kiln Agr'l Lime	Wrightsville, Pa.	**95.42**	80.00	**.44**		**1.94**	
1194	" " "	Sterling Hydrated Lime	Westminster	**67.42**	65.00	**4.24**		**2.92**	
1251	Tidewater Portland Cement Co., Union Bridge, Md.	Agr'l Lump Lime	Union Bridge	**96.98**	92.00	**.79**	1.00	**1.55**	
1196	Tidewater Portland Cement	Hydrated Lime	Mt. Airy	**70.22**	70.00	**1.19**		**1.24**	

1196	Tidewater Portland Cement Co., Union Bridge, Md.	Hydrated Lime	Mt. Airy	**70.22**	**70.00**	**1.19**		**1.24**
1256	Tilghman Lime Co., Fruitland, Md.	Diamond Br. Hyd. Lime	Fruitland	**60.70**	60.00	**.45**	1.00	**5.50**
1215	" " "	Diamond Br. Hyd. Lime	Fruitland	**57.67**	60.00	**.14**	1.00	**8.65**
1216	" " "	Star Br. Hyd. Shells	Fruitland	**56.55**	50.00	**.29**	1.00	**9.32**
1263	United States Gypsum Co., Chicago, Ill.	Ben Franklin Agr'l Gyp.	Chicago, Ill.	‡**32.59**				
1257	Wm. H. Valliant & Bro., Bellevue, Md.	*Ground Oyster Shells	Bellevue	**48.94**	45.00	**.41**		**1.16**
1217	Chas. Warner Co., Wilmington, Del.	Limoid	Conowingo	**43.56**	42.00	**28.35**	28.00	**2.20**
	" " "	†Limoid-Inoculated Lime						
1240	" " "	Pulverized Burned Lime	Wilmington, Del.	**52.08**	54.00	**34.94**	36.00	**2.02**
1241	" " "	*Pulverized Limestone	Wilmington, Del.	**30.68**	29.00	**20.68**	19.00	**2.37**
1242	" " "	Run of Kiln Lime	Wilmington, Del.	**52.64**	56.00	**37.66**	37.00	**2.85**

* Ground Shells or Stone, Mechanical Analysis on page 10.

† Licensed but no sample.

‡ Pure Gypsum, $CaSO_4$, $2H_2O$, 93%.

TABLE II—SHOWING MECHANICAL ANALYSIS OF GROUND LIMESTONE AND GROUND OYSTER SHELL

For the Chemical Analyses of these samples, see preceding table
Figures are percentages or pounds per hundred
"Mesh" indicates the sieve used: "20 Mesh" has 20 wires to the inch

No.	Name of Manufacturer or Agent	Name of Lime or Kind	Finer than 100 Mesh	Bet. 80 and 100 Mesh	Bet. 60 and 80 Mesh	Bet. 40 and 60 Mesh	Bet. 20 and 40 Mesh	Coarser than 20 Mesh
1243	Alba Marl Lime Co., Charles Town, W. Va.	Alba Marl	14	4	3	9	25	45
1244	Baltimore Pulverizing Co., Baltimore, Md.	Agricultural Lime	37	21	10	22	10	0
1269	J. E. Baker Co., York, Pa.	Victor Fine Gr. Limestone	77	6	2	6	8	1
1220	S. W. Barrick & Sons. Woodsboro, Md.	Ground Lime	62	5	2	4	5	22
1239	Beaver Dam Marble Co., Cockeysville, Md.	Dolomitic Limestone	5	4	3	12	46	30
1227	Beaver Dam Marble Co., Cockeysville, Md.	Ground Stone Lime	22	11	9	25	31	2
1197	Herbert Bryant's Son, Alexandria, Va.	Pulverized Oyster Shells	22	9	6	14	28	21
1211	Chesapeake Shell & Lime Co., Crisfield, Md.	Ground Oyster Shells	27	10	9	12	22	20
1258	Chesapeake Shell & Lime Co., Crisfield, Md.	Ground Oyster Shells	16	8	6	15	30	25
1213	Dorchester Fert. & Lime Co., Cambridge, Md.	Pulverized Oyster Shells	24	14	9	19	30	4
1261	M. J. Grove Lime Co., Lime Kiln, Md.	Pulverized Limestone	23	8	6	14	26	23
1245	Hubbard Fertilizer Co., Baltimore, Md.	Ground Oyster Shells	34	10	5	15	32	4
1260	Maryland Lime Marl Co., Hagerstown, Md.	Lime Marl	30	15	6	13	22	14
1252	Michigan Limestone & Chem. Co., Buffalo, N. Y.	Calcite Mich. Limestone	50	12	6	11	16	5
1272	Natural Lime Marl Co., Roanoke, Va.	Lime Marl	36	10	7	18	19	10
1249	Palmer Lime & Cement Co., York, Pa.	Ground Limestone	100	0	0	0	0	0
1190	Potomac Lime Co., Colonial Beach, Va.	Ground Oyster Shells	21	8	6	13	29	23
1192	Potomac Poultry Food Co., Baltimore, Md.	Oyster Shell Dust	28	12	8	20	30	2
1250	Security Cement & Lime Co., Hagerstown, Md.	Pulverized Limestone	94	4	1	1	0	0
1201	Standard Lime & Stone Co., Buckeystown, Md.	Pulverized Limestone	47	15	10	21	6	1
1257	Wm. H. Valliant & Bro., Bellevue, Md.	Ground Oyster Shells	38	5	2	5	10	40
1241	Chas. Warner Co., Wilmington, Del.	Pulverized Limestone	91	4	2	2	1	0

It will be noted that many of the limes manufactured outside of the State were sampled at the place of manufacture. In such cases the samples were furnished by the manufacturers and it is quite probable that, in many cases at least, the samples are better than if they had been drawn from cars at the point of delivery in this state. This should be given some weight when making comparisons and, in any case, the guaranteed analysis should be given weight, especially when lower than the "analysis found."

The actual value of lime to the farmer depends, other things being equal, on the actual amount of lime (oxide of calcium, CaO) and magnesia (oxide of magnesium, MgO) present. The number of pounds of these constituents that should be expected in 100 pounds of the commercial products and in perfectly pure materials are as follows:

	In commercial material	In pure material
Carbonates: Marble, Limestone, High-grade "Marl," Aged and Dried Gas Lime	50	56
Hydrated Lime (Slaked or "Slacked" Lime)	60-70	74
Lime, Burnt Lime, Lump Lime, Burned Oyster Shells, Ground Lime (High-grade)	90-95	100
Same, Medium grade	80-90	
Same, Low grade, less than	80	

LIMING SOILS

The use of lime is on the increase, as the need for it is becoming better known. Some soils do not need lime and some crops are not benefited by lime. The usual practice is to apply it to land that is being planted with a leguminous crop, as clover, peas, etc., as on a wheat crop when clover is to follow or be sown with the wheat. If it is known that clover will not grow it is probable that lime is required. The simplest chemical test is the litmus test. This test can be made by any one after a little practice. A good way to make the test is as follows:

Blue litmus paper should be cut in pieces about an inch square, though they may be larger or smaller. A number of tumblers of clear glass should be at hand. Wet a piece of the litmus paper with rainwater and place against the inside of a tumbler close to the bottom. The sample of soil to be tested should be moistened with pure water till it has the consistency of a thick mortar or mud and packed in the bottom of the tumbler against the litmus paper. In twenty minutes there will be a decided change in color of the paper from blue to red if the soil is acid, the depth of color depending on the amount of acidity of the soil. Of course, the greater the acidity of the soil the more lime will be needed to correct it. In most cases from 500 to 2,000 lbs. per acre of quick lime or twice this amount of ground limestone or oyster shells will be all that will be necessary. When making the litmus test it is desirable to have a number of tests at once so as to compare the colors. If one of the samples is taken from a spot where a pile of brush has been burned within a year or two the test will be more striking. This sample will be alkaline and the litmus should remain a bright blue.

More elaborate tests than the above had best be made in a regular laboratory, for which one should write to "Department of Soils, Experiment Station, College Park, Md."

For further information in regard to liming soils write to "Extension Service, College Park, Md.," for "Bulletin No. 2," and to "U. S. Department of Agriculture, Washington, D. C.," for "Farmers' Bulletins Nos. 921 and 77."